# TAXONOMIC STUDIES OF THE SPECIES OF *HOLOTHURIA* (LINNAEUS, 1767) FROM THE SEAS AROUND INDIA[1]

## Part 1

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(*With a plate and two text-figures*)

**Key words:** *Holothuria,* taxonomy, habits, habitats, Andaman and Nicobar Islands, Gulf of Mannar, Palk Bay, Lakskadweep

In this paper earlier attempts made to revise the genus *Holothuria* Linnaeus, 1767 are given in detail. Of the 26 species known under the genus *Holothuria* from Indian seas, 18 species have been collected by me. These have been described in detail with full synonymy, notes on habits and remarks with figures and photographs. Keys have been provided for all the species known from Indian seas.

### INTRODUCTION

The genus *Holothuria* Linnaeus, 1767 has been subject for revision since the early part of this century. A large number of holothurians have been assigned to this genus and it became very unwieldy to handle and arrange the species correctly. In order to sort out this problem, various attempts have been made in the past to revise the genus. Rowe (1969) considered that the number of valid species under the genus was about 114.

### REVIEW OF EARLIER CLASSIFICATIONS

Pearson (1913-1914) attempted to revise the genus *Holothuria*, based on material from the Indian Ocean. He divided the genus *Holothuria* into five subgenera, namely *Bohadschia* Jaeger, *Actinopyga* Bronn, and included three new subgenera *Argiodia, Halodeima* and *Thymiosycia.* He was of the opinion that by the elaboration of the simple branched rods and rosettes of the species *Actinopyga* and *Bohadschia*, perforated plates, and later, buttons and tables could have developed. He considered that the calcareous ring of *Actinopyga* and *Bohadschia* are primitive since they lack the anterior and posterior projections and have deep ampullar notches. In the genera *Argiodia*, *Halodeima* and *Thymiosycia*, the radial and interradial plates of the calcareous ring show marked projections. The radial plates are also markedly longer than the interradial plates. He did not give much taxonomic importance to the presence or absence of anal 'teeth' or papillae. He was of the view that the arrangement of the tubefeet in *Actinopyga* and *Bohadschia* also showed that they are more primitive than his three new genera. Pearson (1913, 1914a, b) dealt only with a few species from the Indian Ocean, so his revision was incomplete.

Panning (1929-35) did an admirable job by bringing all the information on the genus *Holothuria* together, but, according to Deichmann (1958), this magnificent work suffered from his dependence in too many cases on the accounts of earlier workers; hence many errors have been perpetuated and related forms have been placed far apart. In his revision of *Holothuria*, he treated *Actinopyga*, *Bohadschia* and *Microthele* as subgenera. Later, Panning (1939) revised his treatment of *Holothuria*. He

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was not sure of the relationship between *Actinopyga* and *Bohadschia* since he did not consider the presence or absence of anal papillae to be of great importance, but he concluded that there could be no relationship between *Actinopyga* and *Microthele*, the possession of anal papillae in both being the result of convergence.

Deichmann (1958) felt that the name *Holothuria* Linnaeus (i.e. *sensu* 1758) should be discarded and the species previously included in it divided into a number of genera. She proposed 13 generic names, of which 11 were new to science. According to Rowe (1969), by erecting new genera she disregarded a number of appropriate prior genus group-names of Brandt (1835), Jaeger (1833), Haacke (1880) and Pearson (1914) on the grounds of poor definition; most of these names are available under the rules, being associated with recognised species, those of Jaeger and Brandt needing only designation of type-species in order to qualify for recognition under the rules. Deichmann (1958) stated that there was nothing new about her classification, since this type of arrangement of the species on the basis of ecological divisions has been foreshadowed in the key of Fisher (1907) for the Hawaiian holothurians. She based her classification mainly on ecological division. She was of the view that within each habitat are groups in different stages of development, which can be separated by means of their spicules. She was also of the view that the most primitive ones are those with regular tables and rosettes. This is exactly opposite to the view of Pearson. She based her revision predominantly on the species from the East Pacific and left unconsidered a number of others from different parts of the world, so that her revision was necessarily incomplete.

Rowe (1969) reviewed the Family Holothuriidae and proposed a new classification. He had two great advantages. He had access to the vast collections of the British Museum and also the benefit of advice of Miss A.M. Clark, the foremost echinodermologist in the world today. He considered the balance of those species not taken into consideration by Deichmann and brought her system into line with the rules of nomenclature. During the last 20 years, most of the specialists like Liao (1975, 1978), Price (1981, 1982, 1983), A.M. Clark (1980, 1984), Price and Reid (1985), Marsh (1986), James (1986a, 1989a) and Cherbonnier (1988) followed his classification without any comment. The classification proposed by Rowe is technically sound and is in conformity with the rules of nomenclature. It is hoped that other species under the genus will be assigned to the various subgenera in due course.

During the last thirty years, I made extensive collections from various places along the mainland of India and collected large samples from the Gulf of Mannar and Palk Bay. I also collected material from the Lakshadweep and the Andaman and Nicobar Islands. From the literature, it is seen that 26 species are known from the seas around India. In this paper 18 species collected by me are described with notes on synonymy, habits and, in some cases, remarks. *Holothuria rugosa* is already referred to the genus *Labidodemas* and is placed under a new family Labidodematidae by James (1981b). Special care is taken to see that all the species of *Holothuria* mentioned in earlier papers are correctly assigned as far as possible. Some of the corrections have already been notified by James (1983). The diagnosis and keys to various subgenera are taken from Rowe (1969).

## Genus *Holothuria* Linnaeus, 1767

**Diagnosis:** Tentacles 17-30, usually 20, papillae and pedicels arranged variously on the

dorsal and ventral sides respectively; anal papillae variously developed or absent; body wall 2-20 mm in thickness; body form variously developed, vermiform, cylindrical or with the ventral side distinctly flattened and 'sole'-like, dorsally arched; size ranging from small to large even up to 600 mm in length; calcareous ring more or less well developed, usually with radial plates two or three times as long as interradial plates, anterior margin of the ring rarely scalloped, posterior margin undulating (except in the subgenus *Theelothuria* where the radial plates bifurcate posteriorly); spicules very diverse and variously developed, tables present or absent, rosettes and small branched rods sometimes present.

**Type species:** *H. tremula* Linnaeus, 1767 (non *H. tremula* Gunnerus, 1767= *H. tubulosa* Gmelin, 1890: Validated, Opinion 80, 1924: 17-18).

26 species of *Holothuria* belonging to 12 subgenera are reported from the seas around India. Of these, 18 species belonging to all the 12 subgenera have been collected and described in detail in this work. Keys to all the species known from the sea around India are given. The following key to the various subgenera is modified from Rowe (1969).

KEY TO THE SUBGENERA OF THE GENUS

1. Spicules: perforated or thorny rods or plates; tables and buttons absent . . . . . *H. (Selenkothuria)* Deichmann, 1958
1'. Spicules: tables always present, usually well developed, alone or in combination with buttons, pseudobuttons, rods or rosettes . . . . . 2
2. Spicules: tables always present in combination with rods or rosettes, never with buttons or pseudobuttons . . . . . 3
2'. Spicules: tables always present in combination with buttons or pseudobuttons, no rosettes or rods . . 5
3. Spicules: tables present in combination with rosettes; no rods in body wall . . . . . 4
3' Spicules: tables present in combination with rods in the body wall, tables usually with reduced disc and spire of moderate height, either rounded at the tip or terminate in a few spines which form a single or double Maltese cross when viewed from above; no rosettes . . . . . *H. (Semperothuria)* Deichmann, 1958
4. Spicules: tables usually with reduced disc and moderately high or high spire, ending in a few spines forming a Maltese cross when viewed from above . . . . . *H. (Halodeima)* Pearson, 1914
4'. Spicules: tables large and clumsy with spinose well-developed disc, its rim is often turned up to give a 'cup and saucer' appearance to the table in lateral view, spire low to moderate height . . . . . *H. (Acanthotrapeza)* Rowe, 1969
5. Spicules: tables variously developed, never modified into hollow fenestrated spheres; buttons smooth, regularly or irregularly developed, often twisted. . . .6
5'. Spicules: tables always strongly developed, sometimes modified into hollow fenestrated spheres; buttons always knobbed or rugose or modified to form hollow fenestrated ellipsoids . . . . . 9
6. Spicules: tables usually well developed, the rim of the disc not spinose; buttons not twisted, sometimes flat and thin, with or without an apparent median longitudinal ridge, outlines regular or irregular. . . . .7
6'. Spicules: tables more or less well developed, disc usually spinose; buttons irregular or twisted, never flattened, lacking any appearance of a median longitudinal ridge . . . . . 8
7. Spicules: tables well developed, disc smooth and round, usually with ten or more peripheral holes, spines of moderate height, ending in several small spines; buttons oval, thin, flat, very rarely with a few knobs, an apparent median longitudinal ridge present, three to six pairs of relatively small holes, buttons regular or irregular in outline . . . . . *H. (Platyperona)* Rowe, 1969
7'. Spicules: tables fairly stout, disc smooth, squarish in outline, usually with eight regular peripheral holes, spire of moderate height ending in a cluster of small spines; buttons not thin or flat and lacking any appearance of longitudinal ridge usually with three pairs of comparatively large holes and regular in outline . . . . . *H. (Thymioscycia)* Pearson, 1914
8. Spicules: tables not strongly developed, rim of disc usually spinose, spire low, ending usually in a ring of spines or cluster of spines, tables occasionally degenerate or incomplete; buttons irregular though not twisted, usually with three pairs of holes, or else

incomplete, forming small lobed rosette-like bars . . . . . *H. (Mertensiothuria)* Deichmann, 1958

8'. Spicules: tables always well developed rim of disc spinose and turned up to give a 'cup and saucer' aspect to the table in lateral view, spire low to moderate in height, usually terminating in a ring or a cluster of small spines; pseudobuttons abundant, smooth, usually irregular and often reduced to single row of three or four holes, occasionally buttons quite regular with three pairs of holes . . . . . *H. (Lessonothuria)* Deichmann, 1958

9. Spicules: tables with disc usually knobbed, spire low, bearing many short spines which are sometimes so numerous and closely crowded that they may almost either obscure the disc or become connected to the knobs of the margin of the disc, thus forming a fenestrated sphere; buttons usually simple, with large regularly or irregularly arranged knobs, generally three to four or more pairs of relatively small holes which may become somewhat obscured by the size of the large knobs . . . . . *H. (Cystipus)* Haacke, 1880

9'. Spicules: tables stout, well developed spire moderate or high, never modified into hollow fenestrated ellipsoids . . . . . 10

10. Spicules: tables well developed, disc smooth or spinose, spires either moderate or high, usually terminating on a cluster of small spines, tables with spires perfectly smooth and tapering to a point, giving the whole table a tack-like appearance usually also present; buttons either simple with irregular, moderate sized knobs, or modified into hollow fenestrated ellipsoids, calcareous ring with radial plates usually possessing more or less well developed posterior bifurcate prolongations . . . . . *H. (Theelothuria)* Deichmann, 1958

10'. Spicules: tables well developed, disc smooth, often squarish in outline, spire of moderate height or high, terminating in small spines, never pointed and tack-like, buttons simple with moderate sized knobs or modified into hollow fenestrated ellipsoids, calcareous ring never with any indication of posterior bifurcate prolongations on the radial plates . . . . . 11

11. Spicules: tables well developed with smooth disc, spire of moderate height or high, terminating in several small spines; buttons simple, with moderate sized, irregularly arranged knobs and three to six pairs of relatively large holes, buttons never modified into hollow fenestrated ellipsoids . . . . . *H. (Metriatyla)* Rowe, 1969

11'. Spicules: tables as per 11, buttons hollow fenestrated ellipsoids though a few simple knobbed buttons may be present . . . . . *H. (Microthele)* Brandt, 1835

## Subgenus *Selenkothuria* Deichmann, 1958

**Diagnosis:** Tentacles 20; pedicels crowded but more or less distinctly arranged in three rows on the ventral 'sole', papillae small, numerous, scattered dorsally; body wall soft, not very thick, about 1-3 mm; body with flattened ventral 'sole' and arched dorsally; size moderate up to 150 mm long; calcareous ring with radial plates up to three times as long as the interradial plates, the latter usually with the outer surface slightly concave; spicules consisting of perforated or rugose plates or rods, tables rare or more often totally absent.

**Type species:** *Holothuria lubrica* Selenka, 1867 (Designated by Deichmann, 1958: 314).

Two species are known under this subgenus from the Indian seas. Both the species have been collected and described in the present work.

KEY TO THE SPECIES OF THE SUBGENUS

Spinose rods present, colour brown . . . . . *H. (Selenkothuria) moebii* Ludwig, 1833

Flattened plates and rods present; colour brownish-black.. . . . . *H. erinaceus* Semper, 1868

## **Holothuria (Selenkothuria) moebii** Ludwig (Fig. 1, A)

*Holothuria moebii* Ludwig, 1833, p. 171; James, 1969, p. 61: Gulf of Mannar & Arabian Sea; James, 1982, p.5; James, 1988b, p. 404: Gulf of Mannar.

*Holothuria lubrica* Koehler & Vaney, 1908, p. 10: Andaman Islands, Sri Lanka. (Non *H. lubrica,* Selenka, 1867); Gravely, 1927, p. 163: Gulf of Mannar; Satyamurti, 1976, P. 45: Shingle & Krusadai Islands.

*Holothuria (Selenkothuria) moebii* Mary Bai, 1980, p. 11; James, 1986a, p. 585: Sri Lanka, Gulf of Mannar-Palk Bay.

**Material:** Mandapam Camp (Gulf of Mannar), 1 specimen; Vizhinjam (Arabian Sea),

4 specimens; Ratnagiri (Arabian Sea), 2 specimens, all collected from the intertidal region attached to stones.

**Description:** Length ranges from 137 mm to 146 mm. Body spindle-shaped, with a bulge at the middle when alive. Ventral side clearly demarcated into a 'sole' which has four distinct rows of pedicels. Dorsally, the papillae are sparsely arranged. In one specimen dissected there were 19 small stone canals and a single polian vesicle.

Calcareous ring large and massive. Radials much larger than the interradials and circular in outline with a cleft at the top. Interradials like small stumps.

Spicules (Fig. 1, A) consist of spinose rods with finely spinulated surface. Mostly simple with a hole at each end. Some of the rods have three or four rays. The length of the rods varies from 0.052 to 0.189 mm and the breadth from 0.010 to 0.049 mm. Pedicels have large end plates and curved rods.

The colour in the living condition is dark brown on the dorsal side and light brown on the ventral side.

**Notes on habits:** This species is collected near the low water mark under stones. They were found to be firmly attached to rocks by the pedicels. During low tide the holothurians contract and become bulged at the centre and remain in the same condition until the tide rises. H.L. Clark (1938) has stated that the normal habitat of the species is well below the lower water mark in the face of the reef.

**Distribution:** It is known from Mauritius, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, China & Southern Japan and the South Pacific Islands. It was recorded for the first time from the Arabian Sea by James (1969).

## **Holothuria (Selenkothuria) erinaceus** Semper (Pl. 1, A & B and Fig. 1, B & C)

*Holothuria erinaceus* Semper, 1968, P. 91: North Australia, Philippines, South Pacific Islands.

*Holothuria andersoni* Bell, 1886, p. 28: Mergui Archipelago.

*Holothuria marenzelleri* Ludwig, 1887, p. 1229: Ceylon (Sri Lanka); Theel, 1886, p. 207: Nicobar.

*Holothuria lubrica* var. *glaberrima* Panning, 1934, p. 47.

*Holothuria (Selenkothuria) erinaceus* Mary Bai, 1980, p. 11; Soota, Mukhopadhyay & Samanta, 1983, p. 512: Interview Island, Port Blair, Nancowry; James, 1986a, p. 585. Sri Lanka, Andaman-Nicobar Islands.

*Holothuria (Selenkothuria) glaberrima* Soota *et al.*, 1983, p. 519: Andaman & Nicobar Islands.

**Material:** Port Blair (Andamans), several specimens, collected from mud-flats in the intertidal region.

**Description:** Ranges in size from 60 to 160 mm in length. This species does not grow to a large size. Body spindle-shaped with a very soft body wall. Posterior end narrow with the anus surrounded by fine papillae. One of the specimens collected had two posterior ends (Pl. 1, B). Tentacles small. Dorsally a few scattered papillae. Ventrally the pedicels are arranged in three bands. In the central band, the pedicels are arranged in two rows, and in the other two bands they are arranged in a single row.

A single polian vesicle, very few cuvierian tubules present, radials rectangular with a distinct notch at the anterior end and a concavity at the posterior end (Fig. 1, C). Interradials half the size of the radials and have a distinct stump at the anterior end.

Spicules (Fig. 1, B) mostly short, flat, dumb-bell shaped rods with a few lateral or terminal holes. there are also a few oval plates with several holes at the margin. The length of the rods varies from 0.052-0.082 mm and breadth from 0.019 mm to 0.032 mm.

In the living condition the colour is light

brown to brownish-black. Small specimens are light pink in colour.

**Notes on habits:** The species is distributed in the supra-littoral zone. It is usually found under stones. At low tide, on lifting stones the anterior end of the body is seen as a brown round patch free from sand and in a shallow depression. The posterior end is also kept near the surface of sand since, on disturbing the animal, a jet of water is released. In the Marina area near Port Blair where there is a lot of mud 3-5 specimens were distributed per square metre. On walking over the mud, due to the pressure caused on the surrounding area, a jet of water is ejected by nearby specimens. Though common, it is overlooked unless one makes a careful search for it in the supralittoral zone. In some places it is truly gregarious. As many as 30 specimens were distributed in a one square metre area at some places. When the tide recedes, they come out of the sand or mud and keep a small portion of the anterior end (about 30 mm in length) outside with the tentacles spread out.

**Distribution:** It is known from Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines and South Pacific Islands.

Subgenus *Semperothuria* Deichmann, 1958

**Diagnosis:** Tentacles 20; pedicels more or less distinctly arranged in three rows on the ventral side, papillae scattered dorsally; body-wall soft, not very thick (1-4 mm); body slender and cylindrical; size moderate up to 150 mm long; calcareous ring quite well developed, radial plates up to three times as long as the interradials; spicules consisting of tables in combination with rods, the former with disc reduced or absent, spire high and terminating in a few spines which form a single or double Maltese cross when viewed from above, rosettes totally absent.

**Type species:** *Holothuria languens* Selenka, 1867; designated by Deichmann, 1958: 303.

Two species are known under this subgenus from the seas around India.

KEY TO THE SPECIES OF THE SUBGENUS

Only tables with flattened base in the body wall . . . . . *H. (Semperothuria) imitans* Ludwig, 1875

Tables and finely spinose rods in the body wall . . . . . *H. (Semperothuria) cinerascens* (Brandt, 1835)

## Holothuria (Semperothuria) cinerascens (Brandt)

*Stichopus (Gymonochirota) cinerascens* Brandt, 1835, p. 51.

*Holothuria cinerascens* Bell, 1867b, p. 654: Ceylon (Sri Lanka); Pearson, 1913, p. 64: Maldives, Seychelles, Ceylon (Sri Lanka); James 1969, p. 61: Mandapam (Gulf of Mannar), Vizhinjam (Arabian Sea), Minicoy (Lakshadweep), Rangat Bay (Andamans); Daniel and Haldar, 1974, p. 428: Lakshadweep and Maldives.

*Halodeima cinerascens* Clark and Davies, 1965, p. 600: Maldives.

*Holothuria (Semperothuria) cinerascens* Mary Bai & Ramnathan, 1977, p. 380: Coast of Kanyakumari (Cape Comorin); Mary Bai, 1980, p. 11; A.M. Clark, 1984, p. 99: Seychelles; Sirvoiker & Parulekar, 1986, p. 279: Goa; Mukhopadhyay & Samanta, 1983, p. 302: Lakshadweep; James, 1983, p. 93; Soota, Mukhopadhyay & Samanta, 1983, p. 513: Rutland Island (Andamans); James, 1986a, p. 585: Lakshadweep-Maldives, Sri Lanka; Mukhopadhyay, 1988, p. 1988, p. 4: Krusadai Island; James 1989b, p. 124: Chetlat, Bitra, Kiltan, Amini, Androth, Kavaratti, Minicoy (Lakshadweep).

**Material:** Mandapam (Gulf of Mannar), 1 specimen; Ratnagiri (Arabian Sea), 2 specimens; Vizhinjam (Arabian Sea), several specimens; Chetlat, 2 specimens; Bitra, 2 specimens; Kiltan, several specimens; Kadmat, 3 specimens; Amini, several specimens; Androth, one specimen; Kavaratti, 3 specimens; Minicoy, several specimens; all specimens collected under coral stones.

**Description:** Ranges in length from 30 mm

to 200 mm. Robust, sub-cylindrical with dorsal and ventral sides sharply differentiated. Dorsal surface covered with uniformly distributed numerous papillae. Ventrally beset with crowded robust pedicels. Tentacles 20 in number, large and sub-globose when fully expanded. Mouth ventral. Posterior end of the body blunt. Anus surrounded by papillae. Body wall thick and fairly smooth to touch. Pedicels more or less arranged in three rows. Papillae of dissimilar sizes. In the living condition the tentacles, though peltate, appear to be slightly arborescent. The collar surrounding the tentacles is inconspicuous.

The calcareous ring is of the usual type. There were four polian vesicles of dissimilar size in one specimen dissected. On the right side of the mesentery there is a single stone canal. Cuvierian tubules are well developed. Longitudinal muscle bands are thin.

Spicules (Fig. 1, D) are of two types, namely tables and rods. Rods simple and finely granulated, a characteristic of the species. They are either straight or curved with the extremities often branched or with coarser tubercles. Occasionally, triradiate and tetraradiate rods occur with three or four ends considerably branched. The length of the rods varies from 0.10 mm to 0.30 mm. Tables simple with the annular disc varying in size from 0.042 mm to 0.060 mm. Four large holes at the centre and four large holes near the margin in each disc of the table. The crowns of the tables are subquadrate, being 0.045 mm in diameter.

Colour in living condition is reddish-brown with some of the papillae and pedicels yellowish in colour.

**Notes on habits:** This species is characteristic of rocky shores. Both small and large forms (30-200 mm in length) were found at the same locality in large numbers. Individuals were often found attached firmly at the rock edges by the three rows of pedicels on the ventral side. The tips of the peltate tentacles are branched, and during high tide the tentacles were observed to move gently, probably to procure planktonic food. It is provided with profuse cuvierian tubules which are discharged when the animal is disturbed. It is a surf-loving form extending up to the supralittoral zone. During low tide, individuals are exposed for a long time but they remain in the splash zone.

**Distribution:** It is known from islands of the Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South East Arabia, Maldives, Sri Lanka, East Indies, North Australia, Philippines, Japan, South Pacific Islands and Hawaiian Islands. James (1969) recorded this species for the first time from the Arabian Sea.

## Subgenus *Halodeima* Pearson, 1914

**Diagnosis:** Tentacles 20; pedicels in three distinct but crowded rows on the more or less distinctly 'sole'-like ventral side, papillae small and irregularly arranged on the dorsal surface; body wall soft, quite thick, usually 2-3 mm; body almost cylindrical; size moderate to large, up to even 600 mm long; calcareous ring quite stout, radial plates up to three times the length of the interradials; spicules consist of tables usually with reduced disc, spire moderate or high, ending in a few spines forming a Maltese cross when viewed from above, no large flattened or spinose rods present in the body wall.

**Type species:** *Holothuria edulis* Lesson, 1830; designated by H.L. Clark, 1921, p. 184.

**Remarks:** The genus *Ludwigothuria* Deichmann, 1958 is a synonym of this subgenus.

Two species are known under this subgenus from the Indian Seas. Both the species have been collected and described in this work.

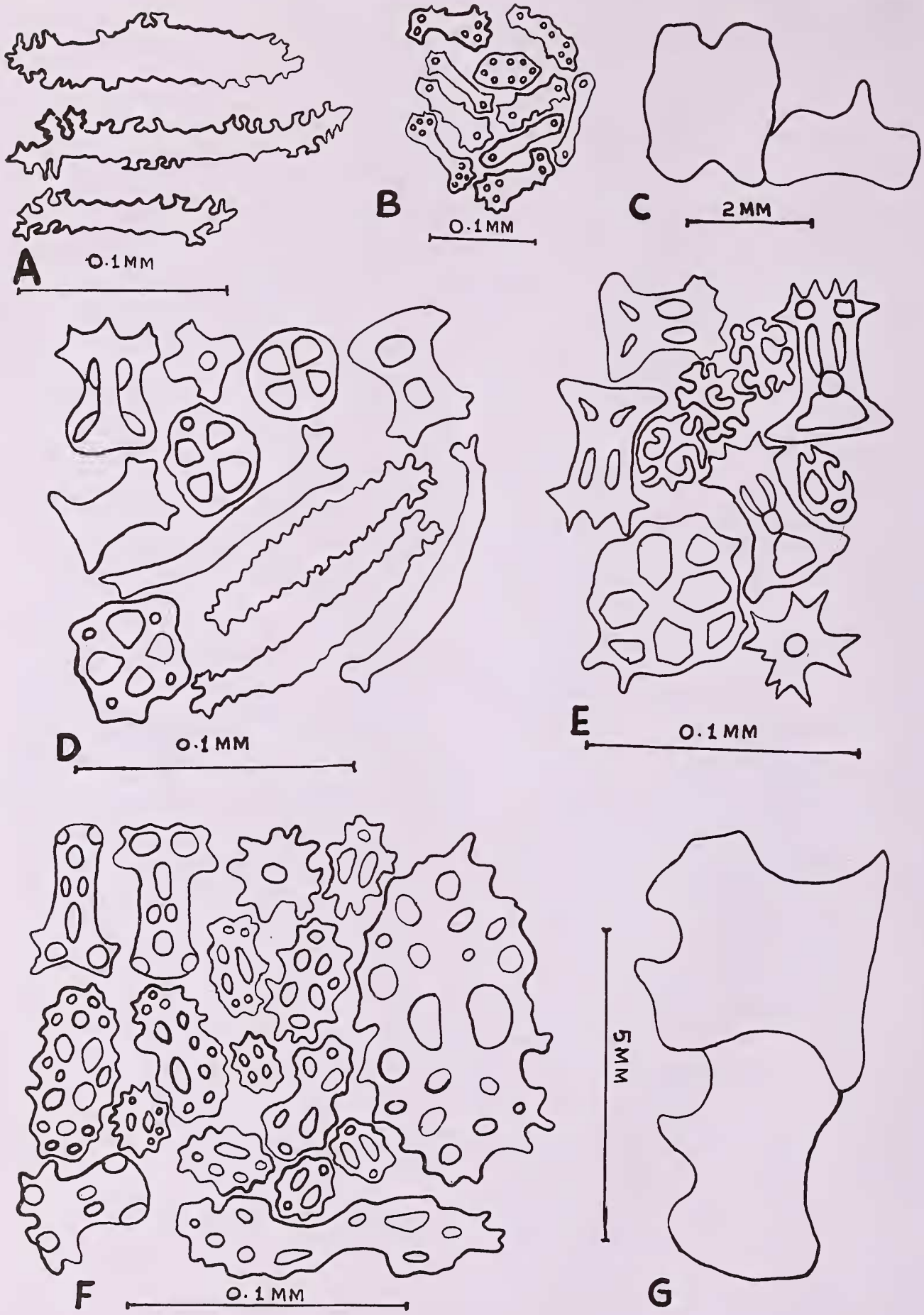



Fig. 1. Spicules of A. *Holothuria (Selenkothuria) moebii,* B. *Holothuria (Selenkothuria) erinaceus; C.* Radial and interradial plates of *Holothuria (S.) erinaceus*; D. *Holothuria (Semperothuria) cinerascens*; E. *Holothuria (Halodeima) atra*; F. *Holothuria (Halodeima) edulis*; G. Radial and interradial plates of *Holothuria edulis.*

KEY TO THE SPECIES OF THE SUBGENUS

Spicules: rosettes present, discs of tables small; colour uniformly dark brown or black . . . . . *H. (Halodeima) atra* Jaeger, 1833

Spicules: rosettes absent, discs of tables reduced to ring; dorsal side black and ventral side pink . . . . . *H. (Halodeima) edulis* Lesson, 1830

## Holothuria (Halodeima) atra Jaeger

*Holothuria atra* Jaeger, 1833, p. 22; Bell, 1887a, p. 140: Andaman Islands; Bell, 1887b, p. 654: Ceylon (Sri Lanka); Ludwig, 1887, p. 1217: Ceylon; Bell, 1888, p. 389: Tuticorin; Thurston, 1894, p. 115: Pamban; Pearson, 1903, p. 202: Ceylon (Sri Lanka); Herdman & Herdman, 1904, p. 447: Ceylon (Sri Lanka); Koehler & Vaney, 1908, p. 5: Andaman Islands, Galle (Sri Lanka), Flat Island, coast of Arakan; Pearson, 1913, p. 67: Sri Lanka; Gravely, 1927, p. 164: Gulf of Mannar; Patil, 1953, p. 430: Karwar; James, 1969, p. 62: Gulf of Mannar & Palk Bay; Jones & James, 1970, p. 799: Vedalai, Shingle Island, Mandapam; James, 1973, p. 708: Southeast coast of India; Daniel & Haldar, 1974, p. 428: Lakshadweep & Maldives; Satyamurti, 1976, p. 42: Rameswaram, Krusadai Island; Nagabhushanam & Rao, 1979, p. 290: Minicoy Atoll (Lakshadweep); James, 1982, p. 5; James, 1983, p. 98; Rao *et al.* 1985, p. 11: Gulf of Mannar; Tikader & Das, 1985, p. 99: Andaman & Nicobar Islands; Tikader *et al.* 1986, p. 117: Andaman & Nicobar Islands; James, 1986b, p. 4: James, 1986c, p. 1340: Andamans & Mandapam; James, 1988, p. 44: Gulf of Mannar.

*Holothuria (Halodeima) atra* Soota *et al.* 1983, p. 510: Campbell Bay, Port Blair, Car Nicobar, Long Island, Little Andaman, Interview Island; Mary Bai, 1980, p. 12: Price & Reid, 1985, p. 3: Chetlat (Lakshadweep), Galle & Kalpitiya (Sri Lanka); Mukhopadhyay & Samanta, 1983, p. 302: Lakshadweep; James, 1986a, p. 585: Lakshadweep-Maldives, Gulf of Mannar-Palk Bay, Andaman-Nicobar Islands; Mukhopadhyay, 1988, p. 5: Krusadai Island, Mandapam Camp; James, 1989b, p. 189: Chetlat, Kiltan; Kadmat, Amini, Agatti, Kavaratti.

**Material:** Mandapam, Tuticorin (Gulf of Mannar), several specimens; Devipatnam (Palk Bay), several specimens; Vizhinjam, 2 specimens; Karwar, 2 specimens; Chetlat, several specimens; Kiltan, several specimens; Kadmat, 5 specimens; Amini, 3 specimens; Agatti, several specimens; Kavaratti, 2 specimens; all specimens collected from the intertidal region.

**Description:** Length from 90-500 mm but known to grow up to 600 mm. Body elongate, subcylindrical and capable of considerable extension. Posterior end blunt. Mouth in the form of a transverse slit and surrounded by a conspicuous papillose collar. There are 20 tentacles in a double row. Pedicels numerous and crowded on the ventral side. Papillae rather thicker than the pedicels and sparsely arranged. Peristome rather thick, tough and leathery in consistency. Anus terminal.

The calcareous ring is not very large. The radial pieces extend farther forward than interradials. Radials square-shaped, the anterior edge of each radial has a rounded incision while each interradial piece has an anterior tooth. Posterior margin of the interradial arched. In a specimen dissected there were four polian vesicles and 18 stone canals. The right respiratory tree extends forward to the calcareous ring and is firmly attached to the body wall and the left one, which is shorter, is connected with the extensive rete mirabile of the intestine. Cuvierian tubules absent.

The spicules (Fig. 1, E) consist of tables and rosettes. Tables numerous but not crowded. Each table possesses a smaller annular disc and a robust spire composed of four rods and one cross beam. Disc diameter 0.055 mm and commonly consists of a simple ring with perforation at the base of each rod. Cross beam nearer to the disc than to the crown. Spire surrounded by eight robust horizontal and four equally strong, sharp, large vertical teeth. Central hole of the spire subcircular. Height of the spire varies from 0.06 mm to 0.08 mm and the breadth of the crowns is about 0.06 mm. Rosettes small and vary in size from 0.019 to 0.045 mm. Pedicels have well developed terminal plates. A few bilaterally symmetrical

fenestrated plates are present close to the terminal plates of the pedicels. The papillae contain slightly curved smooth or spinose rods, mostly with enlarged fenestrated ends.

In the living condition, the colour is black or very dark brown or reddish-brown. The pedicels have white sucking discs and the papillae have white tips. The stocks of the pedicels and papillae are always black. The tentacles and the peristome are dark brown.

**Notes on habits:** This is one of the most common holothurians around Indian Seas. It is always found fully exposed in shallow water on sandy bottoms. During low tide where water remains as a pool this species is found but it is never encountered under stones.

Specimens ranging from 110-230 mm were found in the lagoon with sand coated on them. Of the 46 specimens examined in the field on one occasion, only two were free from sand on the body. Usually specimens ranging in size from 110-160 mm were common in the lagoon. At some places 1-10 specimens were found to be distributed per square metre. Specimens collected on the outer side of the reef were large ( 400 mm in length) and were found to have the alga *Halimeda* inside the alimentary canal. Suspended matter like mud and sand settles on the surface of the animal and forms a coat. Often there are paired rows of round spots free from sand or mud. This is due to the presence of two rows of dorsal papillae.

Bakus (1973) stated this species has a toxin known as holothurin which kills many forms of life in a tide pool. James (1986c) described the experiments conducted at Port Blair (Andamans) and also at Mandapam. The toxin kills all marine life in two hours time when put in a rock pool.

Jones and James (1970) reported an endoparasitic gastropod *Stilifer* sp. from the cloaca of this species. The occurrence of the parasite is very rare and they also described its early development. Waren (1983) referred it to the genus *Megadenus*.

Conand (1990) has stated that this species is of low commercial value. *H. atra* was collected for processing at Vedalai for the first time in 1992. The specimens ranged from 180-310 mm in length. The processed material is sold at the rate of Rs. 50.00 per kilogram.

**Distribution:** It is known from the islands of the Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South East Arabia, Persian Gulf, Maldives, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, Japan, South Pacific Islands and Hawaiian Islands.

## **Holothuria (Halodeima) edulis** Lesson
(Fig. 1, F & G)

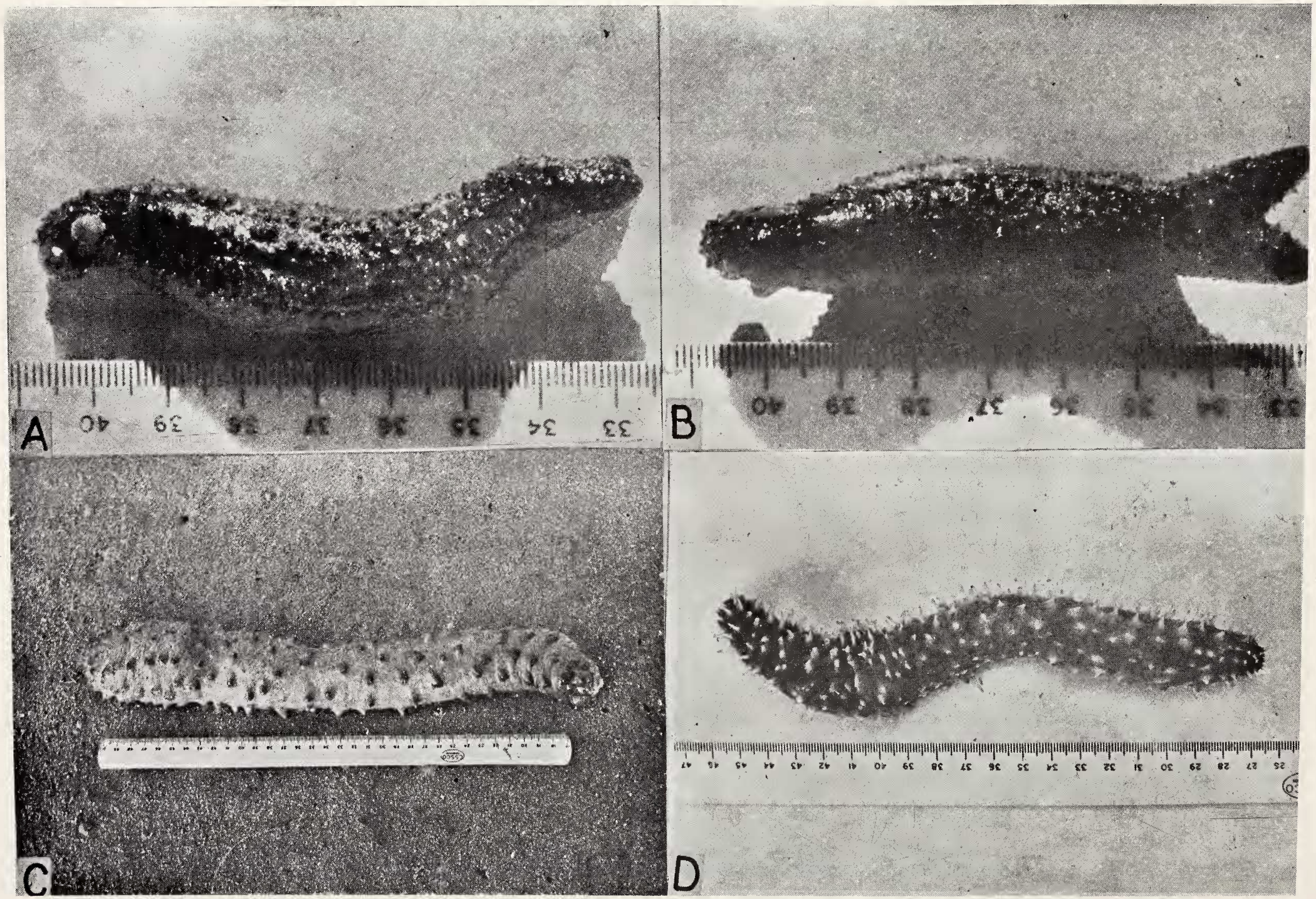
*Holothuria edulis* Lesson, 1830, p. 125; Ludwig, 1887, p. 1227: Ceylon (Sri Lanka); Koehler & Vaney, 1908, p. 7: Andaman Island; James, 1969, p. 61: Gulf of Mannar; James, 1982, p. 5; James, 1983a, p. 98; James, 1988b, p.404: Gulf of Mannar.

*Holothuria albida* Bell, 1887a, p. 140: Andaman Island; Daniel & Haldar, 1974, p. 410: Andamans.

*Holothuria (Halodeima) edulis* Mary Bai, 1980, p. 12; Soota *et al.*, 1983, p. 519: Andaman & Nicobar Islands; Price & Reid, 1985, p. 4: S.W. Kalpitiya (Sri Lanka); James, 1986a, p. 585: Lakshadweep-Maldives, Andaman-Nicobar Islands; Mukhopadhyay, 1988, p. 6: Tuticorin.

**Material:** Mandapam (Gulf of Mannar), 4 specimens, 15 metres; Tuticorin (Gulf of Mannar), 18 metres; Port Blair (Andamans), 2 specimens, 14 metres.

**Description:** Length from 90 mm to 300 mm. Body elongate, narrow at the anterior end and blunt at the posterior end. Minute papillae found on the dorsal side of the body. Numerous pedicels on the ventral side. An arrangement into three rows is discernible in one of the specimens. There are 20 medium-sized tentacles surrounded by a rim of black papillae. Skin smooth and thin. The inner wall of the cloaca is black in colour.




A. *Holothuria* (*Selenkothuria*) *erinaceus* (normal specimen); B. *Holothuria* (*Selenkothuria*) *erinaceus* (specimen with two posterior ends); *Holothuria* (*Acanthotrapeza*) *pyxis*; D. *Holothuria* (*Thymiosycia*) *hilla.*

The calcareous ring (Fig. 1, G) is of moderate size. In one specimen dissected there are 37 stone canals and one polian vesicle. Both the right and left branches of the respiratory trees are large and of equal size.

Spicules (Fig. 1, F) consist of tables and buttons. Discs of tables reduced to a ring which is narrower than the top of the spire. There is a horizontal beam in the middle of the spire. The top of the spire is expanded and bears four blunt spines on each side which can be seen only in the lateral view. Height of the table varies from 0.052 mm to 0.066 mm and diameter of the spire varies from 0.037 mm to 0.043 mm. Small buttons present in the inner layer. The number of holes varies from 3 to 10 and most of them are incomplete. Length of the buttons varies from 0.026 mm to 0.058 mm and the breadth from 0.017 mm to 0.031 mm. Long supporting rods which have expanded ends and three to four holes are present in the pedicels.

In the living condition the body is bright rose pink which may be obscured by varying degrees of black pigment. The black colour is well marked on the dorsal side where it varies from grey to intense black and at the side it is replaced by pink. On the ventral side there is no black colour.

**Notes on habits:** Both in the Gulf of Mannar and at Andamans around Port Blair, this species was collected from shallow depths (4-18 metres). It was never encountered in the intertidal region at both the places. Rowe and Doty (1977) report this species in the intertidal region under stones.

**Distribution:** It is known from East Africa, Red Sea, S.E. Arabia.

Subgenus *Acanthotrapeza* Rowe, 1969

**Diagnosis:** Tentacles 20; pedicels irregularly arranged on the ventral side, papillae small to large and conical, arranged irregularly on the dorsal side; body wall soft, fairly thick, usually 3 (2-5) mm; body almost cylindrical but sometimes ventrally flattened and 'sole'-like; size small to large, up to 450 mm long; calcareous ring stout, radical plates squarish, up to twice as long as interradials; spicules consisting of tables in combination with rosettes, tables usually large and clumsy with well developed spinose disc and low to high spire, the rim of the disc is often turned up to give the tables a cup-and-saucer appearance in lateral view.

**Type species:** *Holothuria pyxis* Selenka, 1867; designated by Rowe, 1969: 138. Three species are included under this subgenus. Only one species is known from Indian Seas.

**Holothuria (Acanthotrapeza) pyxis** Selenka
(Pl. 1, C; Fig. 2, A & B)

*Holothuria pyxis* Selenka, 1867, p. 337: Java; Koehler & Vaney, 1908, p. 14: Andamans; James, 1982, p. 5; Daniel & Haldar, 1974, p. 419: Andamans; James, 1983, p. 93: South Andamans; Tikader *et al.* 1986, p. 120: Andaman & Nicobar Islands; James, 1987, p. 110: Andamans.

*Holothuria papillata* Bell, 1887a, p. 145: Andaman Islands.

*Holothuria (Acanthotrapeza) pyxis* Mary Bai, 1980, p. 12; Soota, Mukhopadhyay & Samanta, 1983. p. 509: Nancowry (Camorta Island); James, 1986a, p. 34: Andaman-Nicobar Islands; James, 1986d, p. 34: South Andamans.

**Description:** The length of the specimens examined varied from 270-450 mm. The body is tubular. The posterior region is bulged and blunt with the anterior end narrow. A number of projections are found on the dorsal side. Some of them are 20 mm in length. They are not arranged according to any order. However, in the smallest specimen (270 mm in length) on the mid-dorsal region there is a double row of tubercles, the arrangement of which is not very distinct. The projections at the sides are not distinctly arranged as a row. In the smallest specimen there are 25 projections longitudinally

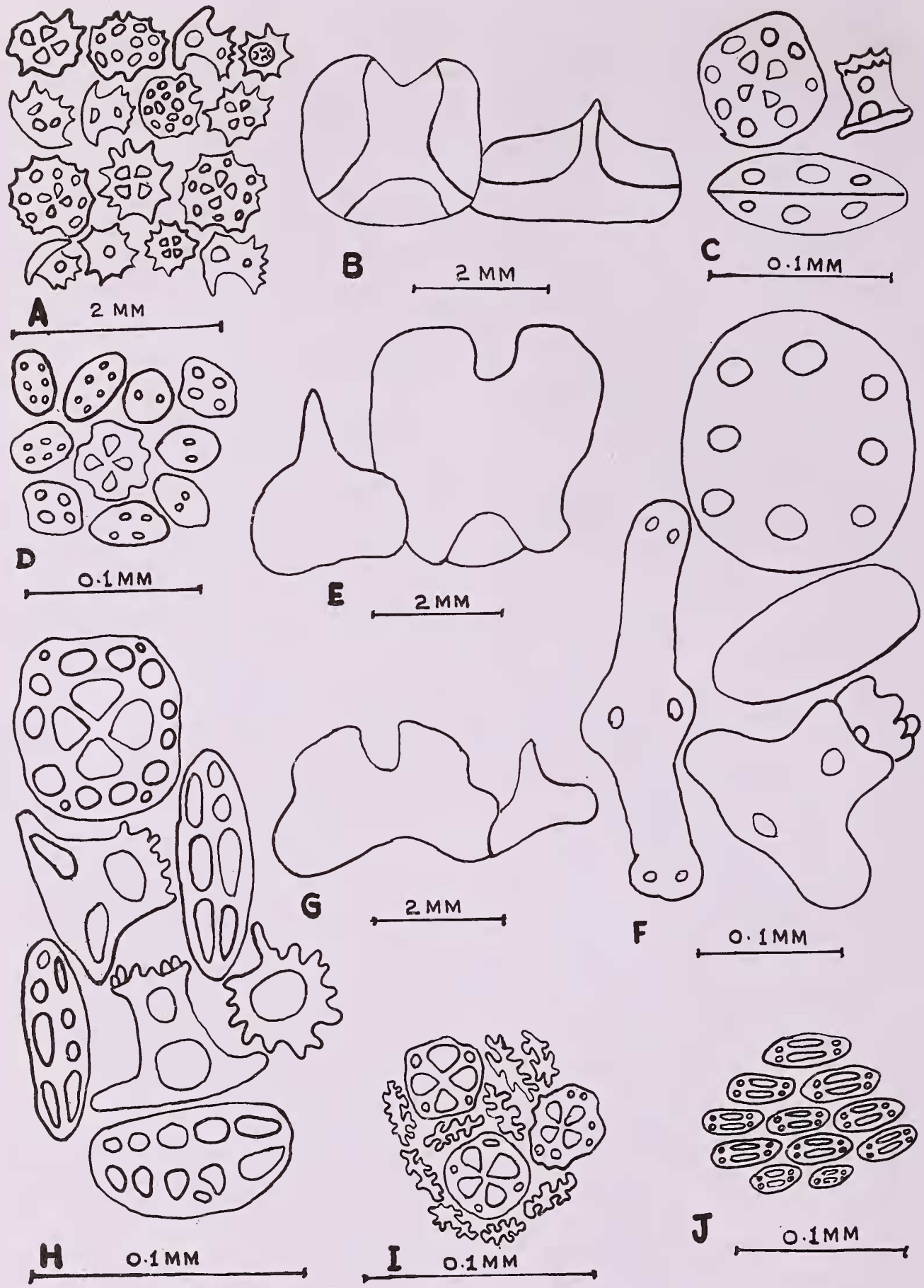



Fig. 2. Spicules of A. *Holothuria (Acanthotrapeza) pyxis*, B. Radial and interradial plates of *Holothuria (A.) pyxis*; C. *Holothuria (Platyperona) difficilis*; D. *Holothuria (Thymiosycia) arenicola*; E. Radial and interradial of *Holothuria (T.) impatiens*; F. *Holothuria (Thymiosycia) impatiens*; G. Radial and interradial plates of *Holothuria (T.) hilla*; H. *Holothuria (Thymiosycia) hilla*; I. *Holothuria (Mertensiothuria) pervicax*; J. *Holothuria (Mertensiothuria) fuscocinerea.*

and four transversely. In the largest specimen (450 mm in length), there are 35 projections longitudinally and five to seven projections transversely. On the ventral side, there are four bands of pedicels. In each band there are five or six pedicels arranged side by side. The pedicels are not evident in preserved specimens.

Radials large with a deep notch at the anterior end, the posterior end straight (Fig. 2, B). Interradials half the height of the radials and have a concavity at the posterior margin. A single stone canal and a single polian vesicle.

The spicules (Fig. 2, A) consist of only tables in the body wall. Margins of the tables spiny with four large holes at the centre and a number of small holes around the margin. Tables short and end in about 10 short spines. Height of the tables is 0.04 mm and diameter of the disc of the tables 0.05 mm.

In the living condition, the dorsal side is brownish-pink with some of the tubercles blackish brown. The ventral side is light brown, with spaces between the bands of the pedicels yellow.

**Distribution:** It is known only from the East Indies and the Andaman Islands. This species is highly secretive and is likely to be taken at other places in the Indo-Pacific region.

**Notes on habits:** The species is always found under large stones which are well fixed to the ground. The long and narrow anterior region is kept out and is seen in constant movement like a snake. It is impossible to pull out the specimen without damaging it since the posterior end is firmly fixed in a crevice of the rock. *Holothuria (Mertensiothuria) leucospilota* also exhibits similar habit though it is easy to take out complete specimens.

**Remarks:** Andaman and Nicobar Islands are well known for the holothurians which are used for *Bêche-de-mer* (James 1983b, 1987). Panning (1944) lists *Holothuria (Acanthotrapeza) pyxis* under the species used for *Bêche-de-mer.* Due to its large size and thick body wall, this species should be well suited for *Bêche-de-mer* preparation. However, the potential of this species for *Bêche-de-mer* industry remains to be exploited.

Subgenus *Platyperona* Rowe, 1969

**Diagnosis:** Tentacles 18-20; pedicels crowded, irregularly arranged except in smaller specimens where they appear to be arranged in three distinct bands on the flattened ventral surface, papillae small, irregularly arranged on the arched dorsal side, a distinct 'collar' of papillae present around the base of the tentacles; body wall soft, not very thick, usually 2 (1-5) mm; body with a distinct flattened ventral 'sole', arched aborally; size small to moderate, up to 200 mm long; calcareous ring stout, radial plates about twice as long as the interradial plates; spicules consisting of well-developed tables, the disc smooth, round and flat, with a varying number of peripheral holes, spires of moderate height, ending in several spines, the buttons oval, thin, flat, very rarely with a few median knobs, a median longitudinal ridge is apparent with three to six pairs of relatively small holes.

**Type species:** *Holothuria difficilis* Semper; designated by Rowe, 1969: 143. Three species are included under this subgenus of which one was collected and is presented in this work.

**Holothuria (Platyperona) difficilis** (Semper)

*Holothuria difficilis* Semper, 1868, p. 92: Samoa; Koehler & Vaney, 1908, p. 6: Andamans.

*Microthele difficilis* A.M. Clark & Davies, 1966, p. 600: Maldives; James, 1969, p. 61: Lakshadweep; Nagabhushanam & Rao, 1972, p. 291: Minicoy Atoll (Lakshadweep).

*Holothuria (Platyperona) difficilis* Mary Bai, 1980, p. 12; Mukhopadhyay & Samanta, 1983, p. 303: Lakshadweep; Soota, Mukhopadhyay & Samanta, 1983, p. 512: Camorta

(Nicobar); Price & Reid, 1985, p. 5: Sri Lanka; James, 1986a, p. 585: Maldives-Lakshadweep, Sri Lanka; James, 1989b, p. 125: Chetlat, Kiltan, Amini (Lakshadweep).

**Material:** Chetlat, several specimens; Amini, Several specimens; Minicoy, two specimens; all collected under stones.

**Description:** Length varies from 60 mm to 180 mm. Ventral side well demarcated from the dorsal.

Papillae scattered on the dorsal side without any arrangement. Pedicels arranged in three bands on the ventral side.

The calcareous ring is of the usual type. The radials have a deep notch at the anterior end a slight concavity at the posterior end. Interradials rectangular with an anterior knob-like projection. Polian vesicles two in number and the stone canal is single. Left branch of the respiratory tree is much longer than the right. Cuvierian tubules thick.

Spicules (Fig. 2, C) consist of table and buttons. Tables short and robust. Spire with four rods and numerous teeth at the top. Discs of the tables either round or squarish, with usually eight peripheral holes and one large central hole. Frequently there are several small accessory holes. The diameter of the table disc is 0.08 mm to 0.09 mm. Buttons large, smooth and vary considerably in size, the average length being 0.1 mm. They are broadly elliptical with six or eight small holes. An apparent median longitudinal ridge is present for each button. The number of holes on each side of the button sometimes varies.

The colour in the living condition is light brown with dark brown blotches. The posterior end is tapering. The ventral side is thickly distributed with pedicels which are yellowish-brown in colour.

**Distribution:** It is known from the islands of Western Indian Ocean, Mascarene Islands, Red Sea, Maldives, Lakshadweep, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, Japan, South Pacific Islands and the Hawaiian Islands. James (1969) reported this species for the first time from the Lakshadweep.

Subgenus *Thymiosycia* Pearson, 1914

**Diagnosis:** Tentacles 18-20; pedicels and papillae usually irregularly arranged ventrally and dorsally, respectively; anal papillae more or less apparent, a 'collar' of papillae usually present around the base of the tentacles; body wall not very thick, usually 2 (1-5) mm; body vermiform; size small to moderate, up to 200 mm (rarely 250 mm) long; calcareous ring stout, radial plates up to three times the length of interradial plates; spicules consisting of fairly stout tables, the flat disc is squarish or irregular in outline, rarely reduced, usually with 8-10 peripheral holes, the spire of moderate height, ending in a cluster of small spines, the buttons regular or irregular in outline with three or more pairs of comparatively large holes (except in *H. (Thymiosycia) arenicola* which has comparatively small holes), not flattened, lacking any appearance of having median longitudinal ridge, rarely buttons present with slight nodules or forming hollow fenestrated spheres.

**Type species:** *Fistularia impatiens* Forskaal, 1775; designated by Pearson, 1914: 164).

**Remarks:** *Brandtothuria* Deichmann 1958, becomes a junior subjective synonym of *Thymiosycia* since its type species, the circumtropical *H. arenicola* Semper, according to Deichmann, is congeneric and consubgeneric with *Fistularia impatiens* Forskaal, the type-species of *Thymiosycia* according to Rowe (1969).

Thirteen species are included under this subgenus. Rowe (1969) is of the opinion that all the nominal species included under the subgenus *Thymiosycia* are not valid. From the Seas around India, five species are known. Three species were collected and included in this work.

KEY TO SPECIES OF THE SUBGENUS

1. Spicules: only tables present . . . . . *H. (Thymiosycia) aphanes* Lampert, 1885
1'. Spicules: tables and buttons present . . . . . 2
2. Spicules: tall spired tables and six-holed buttons present . . . . . *H. (Thymiosycia) remollescens* Lampert, 1885
2'. Spicules: spires of tables not tall . . . . . 3
3. Spicules: buttons with small holes . . . . . *H. (Thymiosycia) arenicola* Semper, 1868
3'. Spicules: buttons with large holes . . . . . 4
4. spicules: tables stout with cluster of short spines at the top . . *H. (Thymiosycia) impatiens* (Forskaal, 1775)
4'. Spicules: tables not stout and with a few spines at the top . . . . . *H. (Thymiosycia) hilla* Lesson, 1830

## **Holothuria (Thymiosycia) arenicola** Semper (Fig. 2, D)

*Holothuria maculata* Bell, 1888, p. 837: Gulf of Mannar; Koehler & Vaney, 1908, p. 11: North Andamans.

*Holothuria (Thymiosycia) arenicola* Mary Bai, 1980, p. 12; James, 1983a, p. 96; Soota, Mukhopadhyay & Samanta, 1983, p. 514: Neil Island (Andamans); James, 1986a, p. 585: Lakshadweep-Maldives; James, 1989b, p. 125: Chetlat, Kadmat, Amini, Androth (Lakshadweep).

**Material:** Port Blair (Andamans), several specimens; Chetlat, four specimens; Kadmat, two specimens; Amini, one specimen; Androth, one specimen; all of them found buried in sand.

**Description:** Length 30 mm to 200 mm. Body slender and vermiform. Mouth small and surrounded by tentacles ventrally. Dorsally, there are a few papillae. Pedicels small and not conspicuous and arranged in three bands ventrally. Midventral band not distinct. In the other two bands there are 3 or 4 pedicels arranged in a row. Anus terminal and surrounded by five groups of four to six short papillae.

The calcareous ring consists of ten pieces, of which the radials are distinctly longer than the interradials. There is a single large polian vesicle and a single stone canal. The gonads are situated in a single tuft on the left side of the mesentery. The respiratory trees are long and much branched.

The spicules (Fig. 2, D) consist of tables, buttons and supporting plates. Buttons smooth and regular with six holes with edges regularly indented between each pair of holes. Sometimes there are two holes on one side and three on the other side. Buttons numerous in the body wall varying in length from 0.065 mm to 0.069 mm, and from 0.030 mm to 0.032 mm in width. Disc of the table with smooth border and quadrate-circular outline. A large hole at the centre and a small hole at the base of each spire. Peripheral holes vary in number from four to ten. Spire made up of four rods, one cross beam and a crown ending in 10 to 20 teeth. Diameter of the disc varies from 0.056 mm to 0.061 mm, and the length of the spire is about 0.041 mm. Supporting rods of the pedicles smooth, dilated at the ends and in the middle where three to five perforations are present. In the middle generally there are two or three oval holes. The length of the supporting rods varies from 0.18 mm to 0.21 mm.

In the living condition, the general colour of the body is white. On the dorsal side, there are three pairs of reddish-brown spots which are of different sizes. The dorsal side is also scattered with very small brown dots which are not conspicuous. The ventral side is uniformly white. In large forms (200 mm in length) there are ten pairs of reddish brown spots. The spots in the middle region are big. In smaller forms (60 mm in length) there are only three pairs of spots. In one specimen there is a light brown ring round the cloaca. In very small forms (30 mm length) the colour is light brownish-yellow with a few irregular light brown blotches. The colour of the spots varies a great deal and Deichmann (1958) has stated that it depends on the colour of sand or mud in which they live.

**Notes on habits:** This is a fairly common holothurian at Port Blair and also at

Lakshadweep. It is an inactive holothurian, often completely buried in sand. At Chetlat, when the tide receded small holes were seen on the sand through which water was gushing out. This is caused by this species. It is almost impossible to take out the specimen completely. The moment we dig they go deeper into sand, and lower down there are big stones which make digging difficult. The pedicels and papillae are highly reduced, therefore the burrowing must apparently be effected only by the contraction of the body muscles. In one of the specimens, a small Carapid fish *Echeliophis (Jordanicus) gracilis* (Bleeker) was found. The details of this association are given by James (in press). Mukerji (1932) gave an account of the fishes associated with holothurians from the Andamans. Arnold (1953) presented some observations on the habits of *Carapus acus*. Jones and Kumaran (1980) reported three species of Carapids from *Bohadschia marmorata.*

**Distribution:** It is a tropical species from the West Indies, Red Sea, Zanzibar, Mascarene Islands, East Indies, Philippines, Southern Japan, Fiji, Hawaii, Tahiti, Galapagos, Cocos Island and eastern coast of Australia. James (1989b) reported this species for the first time from Lakshadweep.

## **Holothuria (Thymiosycia) impatiens** (Forskaal) (Fig. 2, E & F)

*Fistularia impatiens* Forskaal, 1775, p. 121.

*Holothuria impatiens* Bell, 1887a, p. 140: Andaman Island; Bell, 1887b, p.654: Ceylon (Sri Lanka); Ludwig, 1887, p. 1226: Ceylon (Sri Lanka); Bell, 1888, p. 389: Tuticorin (Gulf of Mannar); Koehler & Vaney, 1908, p. 8: Andaman Islands, Great Cocos Island, Point Galle (Sri Lanka); A.M. Clark & Davies, 1966, p. 599: Maldives; James, 1969, p. 61: Red Sea, Lakshadweep, Andamans; Nagabhushanam & Rao, 1972, p. 290: Minicoy Atoll (Lakshadweep); James, 1982, p. 5; James, 1983b, p. 98: Andamans; Tikader & Das, 1985, p. 99: Andaman & Nicobar Islands.

*Holothuria impatiens* var. *bicolor* James, 1969, p. 61: Port Blair (Andamans).

*Holothuria (Thymiosycia) impatiens* Mukhopadhyay & Samanta, 1983, p. 307: Lakshadweep; Soota, Mukhopadhyay & Samanta, 1983, p. 514: Corbyn's Cove, Havelock Island, Katchal Island, Curlew Island, Trinket Island (Andamans); James, 1986a, p. 585: Lakshadweep-Maldives, Sri Lanka, Andaman-Nicobar Islands; James, 1989b, p. 125: Chetlat, Kiltan, Kadmat, Amini, Agatti, Kalpeni, Minicoy (Lakshadweep).

**Material:** Port Blair (Andamans), several specimens; Chetlat, two specimens; Kiltan, two specimens; Kadmat, one specimen; Amini, two specimens; Agatti, one specimen; Kalpeni, two specimens; Minicoy, three specimens (Lakshadweep); all specimens collected in the intertidal region under coral stones.

**Description:** Length from 60 mm to 240 mm. Body bottle-shaped with a long 'neck'. Superficially the body cannot be differentiated dorsally and ventrally. Mouth and anus terminal. Tentacles about 20 crowded around the small mouth. Body surface covered by well developed papillae placed on low, round warts which are conspicuous by their lighter colour than the rest of the body. Papillae scattered fairly evenly over the surface and not in series. Skin unusually sandy to touch.

Radial (Fig. 2, E) pieces of the calcareous ring much larger than interradials and project forward. The rounded margins have a deep concavity. Interradial pieces with short teeth. A single stone canal and one or two polian vesicles. Cuvierian tubules occur in relatively large bunches. Respiratory trees slender with a few branches. Longitudinal muscle bands very thick.

Spicules (Fig. 2, F) consist of tables, buttons and supporting plates. Tables arranged in a crowded manner with the edges of the discs touching or overlapping each other on the outer layer. Each table consists of four upright rods and two cross beams. Spire robust and the top of the spire with a number of teeth which are level with the upper cross beam. Disc subquadrate

usually provided with nine holes forming three rows, central hole larger than the other holes. Diameter of the table discs *c.* 0.10 mm. Spire 0.09 mm high and 0.05 mm in diameter. Buttons oval in shape with mostly three pairs of holes, smooth and with slightly undulating margins and obtuse ends. Very rarely, with more than three holes on each side. Length of the buttons varies from 0.084 mm to 0.10 mm, and breadth from 0.040 mm to 0.049 mm. Supporting rods slightly curved. Central portion dilated like a ring and has invariably two holes. Tips slightly expanded and provided with one to four holes which are generally smaller than those found at the middle. Sometimes the tips of the rods in the papillae are not perforated.

In the living condition, the general colour of the body is light brown with 4 to 5 dark brown transverse bands on the dorsal side at the anterior end. A few dark brown blotches are also found on the dorsal side on the rest of the body. The ventral side is uniformly light brown with three dark bands of the dorsal side extending to the ventral side near the anterior end. In young forms (70 mm length) there are about eight pairs of chocolate brown round blotches, distinct only in the young. The specimen referred to as *Holothuria impatiens* var. *bicolor* by James (1969) has a dark purple body with yellow papillae.

**Notes on habits:** This is one of the commonest holothurians found around Port Blair. It is a secretive form found under dead coral stones. Often, two or three specimens are found under the same stone. It occurs together with *Holothuria (Thymiosycia) hilla.* On disturbing the animals, thick Cuvierian tubules are released. It is an active holothurian unlike *Holothuria (Thymiosycia) arenicola*, which is very inactive.

**Distribution:** It is known from the islands of the Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South East Arabia, Persian Gulf, Maldives, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, Japan, South Pacific Islands, Hawaii and China. James (1969) reported this species from Lakshadweep for the first time.

## **Holothuria (Thymiosycia) hilla** Lesson
(Pl. 1, D; Fig. 2, G & H)

*Holothuria hilla* Lesson, 1830, p. 266; James, 1969, p. 61: Minicoy, Port Blair; Nagabhushanam & Rao, 1972, p. 290: Minicoy Atoll.

*Holothuria monocaria* Bell, 1887a, p. 140: Andaman Islands; Ludwig, 1887, p. 1224: Ceylon (Sri Lanka); Bell, 1888, p. 385: Gulf of Mannar; Pearson, 1903, p. 201: Ceylon (Sri Lanka); Koehler & Vaney, 1908, p. 11: Laccadives(Lakshadweep),MerguiArchipelago,Andamans, Persian Gulf; Gravely, 1927, p. 164; A.M. Clark & Davies, 1966, p. 603: Maldives; James, 1969, p. 62: Gulf of Mannar, Andamans, Lakshadweep; Daniel & Haldar, 1974, p. 428: Lakshadweep & Maldives; Satyamurti, 1976, p. 47: Shingle Island (Gulf of Mannar); James, 1988b, p. 404: Gulf of Mannar.

?*Holothuria ondaatjei* Bell, 1887b, p. 654: Ceylon (Sri Lanka).

*Holothuria (Thymiosycia) hilla* Mukhopadhyay & Samanta, 1983, p. 307: Lakshadweep; Soota, Mukhopadhyay & Samanta, 1983, p. 519: Andaman & Nicobar Islands; James, 1986a, p. 585: Lakshadweep-Maldives, Gulf of Mannar-Palk Bay, Sri Lanka, Andaman & Nicobar Islands; Mukhopadhyay, 1988, p. 8: Pulli, Krusadai, Vedalai, Mandapam Camp, Tuticorin (Gulf of Mannar); James, 1989b, p. 126: Chetlat, Bitra, Kiltan, Kadmat, Amini, Minicoy (Lakshadweep).

**Material:** Mandapam (Gulf of Mannar), 1 specimen; Tuticorin (Gulf of Mannar), Port Blair (Andamans), several specimens; Chetlat, several specimens; Bitra, two specimens; Kiltan, several specimens; Kadmat, three specimens; Amini, two specimens; Minicoy, two specimens; all collected from the intertidal region under coral stones.

**Description:** Length from 50 mm to 200 mm. Body long and cylindrical with blunt ends. Body wall soft. Dorsal and ventral sides demarcated in the living condition. Papillae

sparsely arranged and have expanded bases. Ventral side has numerous pedicels arranged in three rows. A small space at the anterior end near the collar is free from pedicels. Each band of pedicels with five or six tubefeet arranged side by side. Mouth surrounded by 20 inconspicuous papillae. Tentacles small. Ten anal papillae.

The calcareous ring is of the usual type with the radials longer than the interradials (Fig. 2., G.). The right respiratory tree is long, extending up to the anterior end, while the left one is shorter and joins the viscera. Cuvierian tubules are present though not abundant. In a specimen dissected, two polian vesicles and a single stone canal were present.

Spicules (Fig. 2, H) consist of tables and buttons. Tables possess smooth rounded discs. Four large holes corresponding to the four spires in addition to about fifteen peripheral holes. Spire of the tables consists of four pillars and one cross beam which terminates in twelve or more teeth. Buttons oval, smooth and symmetrical with three or four pairs of holes. Holes at either end generally elongate. Length of the buttons varies from 0.17 mm to 0.28 mm. Diameter of the disc tables varies from 0.031 mm to 0.038 mm. In young specimens (60 mm in length), the tables have slightly undulating margins. The papillae have rudimentary terminal plates and curved rod-like perforated spicules.

In living condition, small specimens are chocolate brown in colour and large specimens are golden brown with a circular pale area around the appendages.

**Notes on habits:** This too is one of the commonest holothurians around Port Blair. It is a fugitive species always found under coral stones. Often two or three specimens are found under the same stone along with *Holothuria (Thymiosycia) impatiens*. One of the specimens collected at Port Blair had a Carapid fish *Encheliophis vermicularis* at the base of the respiratory tree. The behaviour of this fish is similar to the fish *Encheliophis* (*Jordanicus*) *gracilis* collected from *Holothuria (Thymiosycia) arenicola* (James, in press).

**Distribution:** It is known from the islands of the Western Indian Ocean, Mascarene Islands, East Africa, Red Sea, South East Arabia, Persian Gulf, Maldives, Sri Lanka, Bay of Bengal, East Indies, North Australia, Philippines, Japan, South Pacific Islands, Hawaiian Islands and China.

Subgenus Mertensiothuria Deichmann, 1958

**Diagnosis:** Tentacles 18-20; pedicels crowded, in smaller forms arranged in three distinct rows ventrally, papillae small, irregularly arranged dorsally, anal papillae or 'collor' or papillae around the base of the tentacles not apparent; body wall variable, soft, ranging from thin to fairly thick, usually about 2-3 (1-4) mm; body almost cylindrical but with a more or less flattened ventral 'sole'; size moderate to large (up to 250 mm long); calcareous ring stout with radial plates about twice as long as the interradial plates; spicules consisting of not very strongly developed tables with the rim of the disc usually spinose and the spire low, ending in a ring or cluster of spines, the tables occasionally degenerate or incomplete, buttons irregular, usually with three pairs of holes, sometimes incomplete.

**Type species:** *Stichopus leucospilota* Brandt, 1835; designated by Deichmann, 1958.

Under this subgenus, six species are included. Three of the species are known from the seas around India, and have been collected and described in this work.

KEY TO THE SPECIES OF THE SUBGENUS

1. Spicules in inner layer resembling narrow rosettes . . . . . *H. (Mertensiothuria) pervicax* Selenka, 1867